WHAT IS CLAIMED IS:

1. A digital receiver for demodulating a digital signal modulated onto a carrier, comprising:

   a tuner;

   an analog to digital converter, for digitizing a channel tuned by said tuner to provide a digitized channel;

   a coarse carrier recovery circuit for extracting said digital signal from said digitized channel at near baseband;

   a feed forward equalizer receiving said digital signal at near baseband and outputting a feed forward equalized signal;

   a fine carrier recovery circuit for phase shifting said feed forward equalized signal by a phase correction angle to adjust for remaining offsets in phase and frequency of said feed forward equalized signal attributable to phase and frequency offsets in said carrier;

   said fine carrier recovery circuit comprising a filter for filtering an estimate of a phase error in said carrier to control said phase correction angle, wherein at least one filter parameter of said filter varies adaptively with said phase error.

2. The receiver of claim 1, wherein said fine carrier recovery circuit further comprises a multiplier and a signal generator for generating a signal to multiply said feed forward equalized signal to phase shift said feed forward equalized signal.

3. The receiver of claim 2, further comprising a threshold slicer for determining a quantized modulated signal corresponding to said digital signal.

4. The receiver of claim 2, wherein said multiplier comprises a sine generator for generating a signal representative of the sine of said phase correction angle.

5. The receiver of claim 3, wherein said filter comprises a phase-locked loop, having an adjustable bandwidth, varied adaptively with said estimate of said phase error.

6. The receiver of claim 5, wherein said phase-locked loop calculates said phase correction angle, as a function of the imaginary portion of said estimate of said phase error.

7. The receiver of claim 5, wherein said phase-locked loop calculates said phase correction angle, as a function of the imaginary portion of said estimate of said phase error multiplied by an adaptive gain.

8. The receiver of claim 7, wherein said fine carrier recovery circuit further comprises an adaptive gain controller for calculating said adaptive gain based on said estimate of said phase error.

9. The receiver of claim 8, wherein said digital signal comprises a plurality of symbols, and said adaptive gain controller calculates said adaptive gain for a current symbol using the imaginary portion of said estimate of said phase error for said current symbol multiplied by an adaptive gain for a previous symbol.

10. The receiver of claim 9, wherein said adaptive gain controller calculates said adaptive gain based on said estimate of said phase error in order to minimize an error in said symbols as demodulated from said carrier.

11. The receiver of claim 8, wherein said digital signal comprises a series of symbols, and said adaptive gain controller calculates said adaptive gain for the nth of said symbols as,

$$k1adapt(n) = k1adapt(n-1) + 2\gamma\alpha(n-1)error\,\mathrm{Im}ag(n-1)), where$$
$$\alpha(n) = (1 - k1adapt(n-1) * error\,\mathrm{Re}al(n) * \alpha(n-1) - error\,\mathrm{Im}ag(n))$$

and γ is a constant, errorImag(n-1) is an estimate of the imaginary portion said phase error for a previously demodulated one of said symbols; errorReal(n) is an estimate of the real portion said phase error for said currently demodulated symbol.

12. The receiver of claim 8, further comprising a low pass filter for filtering said adaptive gain.

13. The receiver of claim 5, wherein said digital signal comprises a series of symbols, and said phase-locked loop calculates said phase correction angle $\phi(n)$ for the nth of said symbols, as

$$\phi(n) = (1 - k0)x\phi(n-1) + k1adapt \times error\,\mathrm{Im}\,ag(n-1) + \theta$$

where θ is a constant; k0 is a gain value; errorImag(n-1) is an estimate of the imaginary portion said phase error for a previously decoded symbol; and said at least one filter parameter that is varied adaptively comprises k1adapt.

14. The receiver of claim 3, wherein said fine carrier recovery circuit further comprises a multiplier and a signal generator for generating a signal to multiply said feed forward equalized signal to phase shift said feed forward equalized signal.

15. The receiver of claim 1, further comprising a phase error detector for estimating errors in real and imaginary components of said digital signal.

16. The receiver of claim 15, wherein said phase error detector has at least two modes of operation, for uniquely estimating errors in said imaginary component in each of said at least two modes.

17. The receiver of claim 16, wherein said phase error detector is operable in a first of said two modes for high quality signals, and in a second mode of operation

18. The receiver of claim 13, further comprising a phase error detector that estimates said imaginary portion of said phase error as one of ($y_i(n)$*$S_q(n)$-$y_q(n)S_i(n)$)*errorNormImag; sign($derot_q(n)$)*($y_i(n)$ -$S_i(n)$) *errorNormImag; $derot_i(n)$*$S_q(n)$*errorNormImag; -$derot_q(n)$*$S_i(n)$*errorNormImag; and $y_i(n)$*$qpsk_q(n)$-$y_q(n)$*$qpsk_i(n)$;

where $y_i(n)$ and $y_q(n)$ are derived from the input of said threshold slicer; $S_i(n)$ and $S_q(n)$ are derived from the output of said threshold slicer; errorNormImag=1/(2π*(| $S_i(n)$ | + | $S_q(n)$|)), where | $S_i(n)$| and | $S_q(n)$ | are the magnitude of $S_i(n)$ and $S_q(n)$, respectively; $qpsk_i(n)$ = 1/(16*π) if $y_i(n)>0$; $qpsk_i(n)$ = -1/(16*π) if $y_i(n)<0$; $qpsk_q(n)$ = 1/(16*π) if $y_q(n)>0$;

$qpsk_q(n) = -1/(16^*\pi)$ if $y_q(n)<0$; $derot_i(n)$ and $derot_q(n)$ represent real and imaginary portions of an output of said fine carrier recovery circuit, respectively; and $sign(derot_q(n))$ extracts the sign of $derot_q(n)$.

19. The receiver of claim 3, further comprising a decision feedback equalizer providing a filtered delayed version of said quantized modulated signal to an input of said threshold slicer.

20. The receiver of claim 19, wherein said estimate of phase error is determined as a function of signals to said input of said slicer and said quantized modulated signals output by said slicer.

21. The receiver of claim 20, wherein said estimate of phase error is further determined as a function of said output of said fine carrier recovery circuit.

22. The receiver of claim 1, wherein said digital signal comprises a vestigial sideband modulated (VSB) signal.

23. The receiver of claim 1, wherein said digital signal comprises a quadrature amplitude modulated (QAM) signal.

24. The receiver of claim 1, formed as an integrated circuit.

25. In a digital receiver for receiving a signal modulated onto a carrier, a method comprising:

    reducing multi-path interference in said signal, by filtering said signal through a feed-forward equalizer to produce a feed forward-equalized signal;

    determining an estimate of a remaining phase error in said carrier;

    filtering said estimate through a filter having at least one adjustable filter parameter to produce a phase correction signal;

    varying said adjustable filter parameter with said estimate of phase error;

    multiplying said feed forward equalized signal by said phase correction signal to de-rotate said feed forward equalized signal.

26. The method of claim 25, wherein said adjustable filter parameter comprises a bandwidth of said filter.

27. The method of claim 25, wherein said phase correction signal is calculated as a function of the imaginary portion of said estimate of said remaining phase error.

28. The method of claim 25, wherein said phase-correction signal is calculated as a function of the imaginary portion of said estimate of said remaining phase error multiplied by an adaptive gain.

29. The method of claim 28, wherein said adjustable parameter comprises said adaptive gain, and wherein said adaptive gain is calculated based on said estimate of said remaining phase error.

30. The method of claim 28, wherein said signal comprises a plurality of symbols, said adaptive gain for a current symbol is calculated using the imaginary portion of said remaining phase error multiplied by an adaptive gain for a previous symbol.

31. The method of claim 29, wherein said adaptive gain is calculated based on said estimate of said remaining phase error in order to minimize an error in said symbols as demodulated from said carrier.

32. The method of claim 28, wherein said signal comprises a series of symbols, and said adaptive gain for the nth of said symbols is calculated as,

$$k1adapt(n) = k1adapt(n-1) + 2\gamma\alpha(n-1)error\,\mathrm{Im}ag(n-1)), where$$
$$\alpha(n) = (1 - k1adapt(n-1) * error\,\mathrm{Re}al(n) * \alpha(n-1) - error\,\mathrm{Im}ag(n))$$

and γ is a constant, errorImag(n-1) is an estimate of the imaginary portion of said remaining phase error for a previously decoded symbol; errorReal(n) is an estimate of the real portion of said remaining phase error for said currently demodulated symbol.

33. The method of claim 25, further comprising providing said feed forward equalized signal to the input of a slicer and at said slicer forming a quantized signal from said input.

34. The method of claim 33, wherein said determining comprises estimating a phase difference between a signal at said input of said slicer and said quantized signal.

35. The method of claim 34, further comprising filtering said quantized signal, and feeding said filtered quantized signal back to said input of said of said slicer to reduce multi-path interference in said signal.

36. The method of claim 35, wherein said quantized signal comprises allowable quadrature amplitude modulated (QAM) symbols.

37. The method of claim 35, wherein said quantized signal comprises allowable vestigial side-band (VSB) modulated symbols.

38. A digital receiver for demodulating a digital signal modulated onto a carrier, to produce a demodulated digital signal, said receiver comprising:

a de-rotator for phase shifting an equalized version of said digital signal by a phase correction angle to adjust for remaining offsets in phase and frequency of equalized version of said digital signal attributable to phase and frequency offsets in said carrier;

a filter in communication with said de-rotator, for filtering an estimate of a phase error in said demodulated digital signal to control said phase correction angle, wherein at least one filter parameter of said filter varies adaptively with said phase error.

39. The receiver of claim 38, wherein said filter comprises a phase-locked loop, having an adjustable bandwidth, varied adaptively with said estimate of said phase error.

40. The receiver of claim 39, wherein said phase-locked loop calculates said phase correction angle, as a function of the imaginary portion of said estimate of said phase error.

41. The receiver of claim 39, wherein said phase-locked loop calculates said phase correction angle, as a function of the imaginary portion of said estimate of said phase error multiplied by an adaptive gain.

42. The receiver of claim 41, wherein said receiver further comprises an adaptive gain controller for calculating said adaptive gain based on said estimate of said phase error.

43. The receiver of claim 42, wherein said digital signal comprises a plurality of symbols, and said adaptive gain controller calculates said adaptive gain

for a current symbol using the imaginary portion of the phase error multiplied by an adaptive gain for a previous symbol.

44. The receiver of claim 43, wherein said adaptive gain controller calculates said adaptive gain based on said estimate of phase error in order to minimize an error in said symbols as demodulated from said carrier.

45. The receiver of claim 42, wherein said signal comprises a series of symbols, and said adaptive gain controller calculates said adaptive gain for the nth of said symbols as,

$$k1adapt(n) = k1adapt(n-1) + 2\gamma\alpha(n-1)error\,\mathrm{Im}ag(n-1)), where$$
$$\alpha(n) = (1 - k1adapt(n-1) * error\,\mathrm{Re}al(n) * \alpha(n-1) - error\,\mathrm{Im}ag(n))$$

and γ is a constant, errorImag(n-1) is an estimate of the imaginary portion said phase error for a previously demodulated symbol; errorReal(n) is an estimate of the real portion of said phase error for said currently demodulated symbol.

46. The receiver of claim 41, further comprising a low pass filter for filtering said adaptive gain.

47. The receiver of claim 39, wherein said signal comprises a series of symbols, and said phase-locked loop calculates said phase correction angle $\phi(n)$ for the nth of said symbols, as

$$\phi(n) = (1 - k0)x\phi(n-1) + k1adapt \times error\,\mathrm{Im}ag(n-1) + \theta$$

where θ is a constant; k0 is a gain value; errorImag(n-1) is an estimate of the imaginary portion said phase error for a previously decoded symbol; and said at least one filter parameter that is varied adaptively comprises k1adapt.